CLAIMS

1/ Digital data processing apparatus comprising a module (M2, M3, M_3") implementing convolution with a function U on a frequency domain data vector Z(k) where k lies in the range 0 to N-1, which convolution corresponds to zeroing samples in the time domain of the inverse transform of Z(k), the apparatus being characterized in that the function U has the form:

$$U(k) = \mathrm{sinc}\left(\frac{k-k_0}{2}\right).e^{-j\pi\left(\frac{\alpha(k-k_0)}{2}\right)}.P(k)$$

where k_0 is a constant integer and P(k) is a weighting window that is symmetrical about k_0.

2/ Apparatus according to the preceding claim, characterized in that k_0 is equal to zero.

3/ Apparatus according to either one of the preceding claims, characterized in that it comprises a module (M_3') receiving a frequency domain vector (H), the module being suitable for inserting between two coefficients of the vector (H) on each occasion an additional coefficient so as to supply a frequency domain vector (H') of increased length.

4/ Apparatus according to the preceding claim, characterized in that the additional coefficients are zeros.

5/ Apparatus according to claim 3 or 4, characterized in that for a frequency domain vector (H') of increased length having indices of 0 to 2N-1, the inserted coefficients are the coefficients having odd indices.

6/ Apparatus according to any one of claims 3 to 5, characterized in that the module (M2, M3, M_3") performing convolution with U is placed downstream from the insertion module (M_3'), and in that Z is the frequency domain vector of increased length (H').

7/ Apparatus according to any preceding claim, characterized in that it includes a filter (H) upstream from the module (M2, M3, M_3") for performing convolution with U, and in that Z is the transfer function of this filter (H).

8/ Apparatus according to the preceding claim, characterized in that it includes means (H) for computing the coefficients of the filter (H) on the basis of a signal (X, S1) input to the apparatus.

9/ Apparatus according to any preceding claim, characterized in that it includes a module (M1) suitable for implementing a transform into the frequency domain of an input time domain signal (S1), said module (M1) being upstream from the module (M2, M3, M_3") for performing convolution with U, and in that Z is said frequency transform (X), possibly associated with an insertion module (M_3') in accordance with any one of claims 3 to 5.

10/ Apparatus according to claims 6, 7, and 9 in combination, characterized in that it comprises a first module (M2) applying convolution with a first function having the form:

$$U(k) = \mathrm{sinc}\left(\frac{k-k_0}{2}\right).e^{-j\pi\left(\frac{\alpha(k-k_0)}{2}\right)}.P(k)$$

on a frequency transform (X) of an input signal (S1) that is optionally augmented, and a second convolution module (M3) applying convolution with a second function having the form:

$$U(k) = \mathrm{sinc}\left(\frac{k-k_0}{2}\right).e^{-j\pi\left(\frac{\alpha(k-k_0)}{2}\right)}.P(k)$$

on the frequency response (H) of a filter (H) that is optionally augmented, the output vectors (X', S3) from these two modules (M2, M3, M_3") having the same number of coefficients, and in that the apparatus has at its output a module (M4) suitable for multiplying together the coefficients of these two output vectors (X', S3).

11/ Apparatus according to any preceding claim in combination with any one of claims 3 to 5, characterized in that the module (M2, M3, M_3") for performing convolution with U supplies an output vector (H', S3) having the same length as the augmented vector Z, by retaining in the output vector (H', S3) those coefficients of the vector Z which were present prior to insertion, and the other coefficients of the output vector (H', S3) being obtained by convolution of Z and U.

12/ Apparatus according to any preceding claim, characterized in that the module (M2, M3, M_3") for performing convolution with U outputs a vector B(0,...,N-1) which is such that for all <u>k</u>, a coefficient in B of index <u>k</u> is equal to a product of convolution

between Z and U which is such that the coefficient of index k in Z is multiplied in said convolution product with the coefficient of index k_0 of U for which the sinc function has an argument of 0.

13/ Apparatus according to any preceding claim, characterized in that the filter U takes non-zero values over a range of values of k which is symmetrical about the value k_0 for which the modulus of U is at its maximum.

14/ Apparatus according to any preceding claim, characterized in that the function U has an odd number of coefficients Lu, and in that U can be written:

$$U(k) = \mathrm{sinc}\left(-\frac{Lu-1}{4}+\frac{k}{2}\right).e^{-j\alpha\pi\left(-\frac{Lu-1}{4}+\frac{k}{2}\right)}.P(k)$$

15/ Apparatus according to any preceding claim in combination with claim 9 or 10, characterized in that the transform is a discrete Fourier transform.

16/ Apparatus according to any preceding claim, characterized in that the weighting window is a Kaiser window having a coefficient of 1.5.

17/ Apparatus according to any preceding claim, characterized in that it constitutes an echo canceller.

18/ Apparatus according to any preceding claim, characterized in that it constitutes a noise reducer.

19/ Apparatus according to any preceding claim, characterized in that $\alpha = 1$.

20/ Apparatus according to any preceding claim, characterized in that $\alpha = -1$.

21/ Apparatus according to any preceding claim, characterized in that it comprises a loudspeaker (100), a microphone (200), an echo canceller (420, 430, 440, 450), and a disturbance reducer (500), the echo canceller including an adaptive filter (470) and a subtracter module (300) delivering the error (Y') between a signal coming from the microphone (200) and a signal obtained by applying the adaptive filter (460) to a loudspeaker signal (100), the adaptive filter (460) adapting its coefficients as a function of said error, and the apparatus including means (495) suitable for

transforming the signal from the microphone into the frequency domain upstream from the subtracter module (300) in such a manner that the subtraction is performed in the frequency domain.

22/ Apparatus according to the preceding claim, characterized in that it has means (430, 440) for transmitting the result of said frequency domain subtraction to the adaptive filter (470) of the echo canceller.

23/ Apparatus according to claim 21, characterized in that the disturbance reducer (500) is placed downstream from the subtracter module (300) and is applied in the frequency domain to the result of the subtraction.

24/ Apparatus according to the preceding claim, characterized in that the disturbance reducer (500) includes an adaptive filter (520) suitable for recalculating its coefficients as a function of a frequency domain input signal (Y') from the disturbance reducer (500).

25/ Apparatus according to the preceding claim, characterized in that the disturbance reducer (500) is placed to receive the frequency domain signal (Y') output from the subtracter module (300) as said frequency domain input signal of the disturbance reducer.

26/ Apparatus according to claim 24 or 25, characterized in that the disturbance reducer (500) forms a loop receiving as input the frequency domain signal (Y') output from the subtracter (300), and applying at its output multiplication by the adapted coefficients of its adaptive filter on the frequency domain signal (Y') output by the subtracter (300).

27/ Apparatus according to any one of claims 24 to 26, characterized in that the same frequency domain signal (Y') is used as an error signal for adapting the adaptive filter (470) of the echo canceller and is multiplied by the coefficients of the adaptive filter (520) of the disturbance reducer (500).

28/ Apparatus according to any one of claims 21 to 27, characterized in that no transform module is placed between the subtracter module (300) and the disturbance reducer (500).